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TRAFFIC SIGNAL AND OPERATIONS OPTIMIZATION STUDY

Michael Mullen, David Holt, Matthew Snead

SIMGINEERS LLC
700 Lavaca Ste. 1401
Austin, TX 78701, USA

ABSTRACT

Optimizing the timing of coordinated traffic signal systems is considered one of the most cost-effective traffic management implementation to reduce delays, stops, fuel consumption and emissions. An optimized traffic signal coordination system will allow for smoother traffic operation that increases capacity, decreases stops, and alleviates high queues. The study corridor is a major highway with a five lane cross section consisting of two through lanes in each direction and a center lane used for left turns.

The initial study model was developed using existing traffic counts, lane geometries, traffic control, posted speed limits and signal timing. Multiple measures of effectiveness are generated using SIMIO, including: total travel time, stops per vehicle, average speed, and cycle length. Once the simulation model is validated, simulated scenarios are compared using the measures of effectiveness to determine the impact on the quality of traffic flow.

1 INTRODUCTION

The heavily traveled commuter corridor carries over 30,000 vehicles per day with average annual traffic increases of between nine and ten percent. The project corridor includes seven signalized intersections and three non-signalized intersections, including an non-signalized entrance and exit to a large grocery store. The current system experiences many traffic accidents as travelers are attempting to access and depart the store. Traffic analysis was conducted to determine traffic flow patterns by time of day in order to determine the number of signal timing plans is needed for the duration of a day. Analysis was conducted using SIMIO modeling software. The model was compared and calibrated to observed conditions to validate the model before analyzing scenarios of optimized coordinated signal timing plans along the corridor. The validated simulation model of the corridor is presented in figure 1.

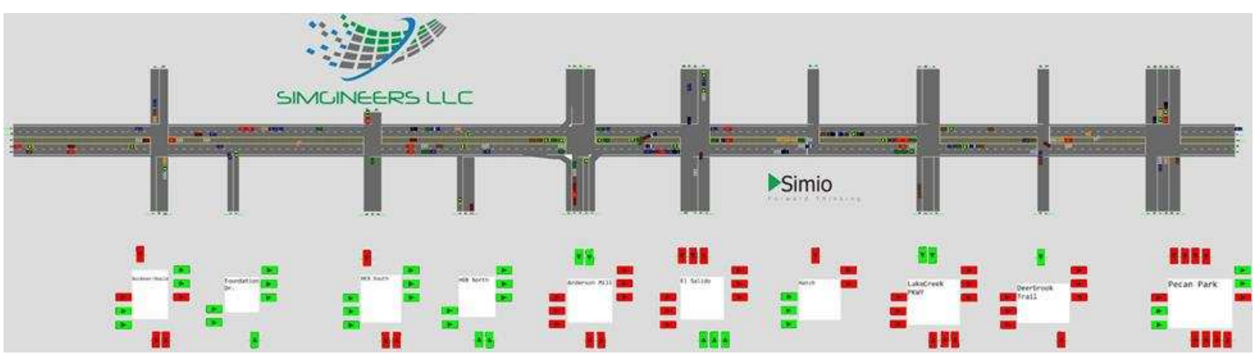

Figure 1: SIMIO Simulation Model

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2 LOGIC

Constraints are implemented into the model by writing general expressions to allow enough time for standard activities and advanced solutions. Standard activities include adequate time for vehicles to clear the intersections and pedestrians to cross intersections, where an advanced solution is a variable written into the simulation that will determine the optimal time split needed for vehicles to safely enter and exit certain establishments. The time splits are implemented at the intersections on either side of these establishments to reduce accidents and maintain efficient green bands to improve traffic flow.

This system works effectively with unequal block length and unequal splits in order to produce a system with efficient green bands for improved traffic flow. The complexity of this corridor arises from allocating effective splits across the seven timed intersections that allow for a safer corridor. This system can be used to favor one direction over the other, for example, inbound traffic flow during morning peak hours at the expense of the fewer vehicles traveling in the opposite direction, and vice versa. Adequate two-way traffic flow coordination can be implemented using certain combinations of cycle length and block spacing between intersections.

3 RESULTS

Given the current lane geometries and traffic demand, an improved plan for traffic flow has been developed for the study corridor through simulated scenarios of synchronized timing plans. Once the model has been calibrated, an optimized set of signal timing plans was developed. These plans established green splits, offsets, and phase sequences that allow the maximized amount of progression in each direction.

Network Measure of Effectiveness	Existing Timings	Simulated Timings
Total Travel Time (hr)	718	423
Stops/Vehicle	0.6	0.54
Total Stops	20470	18441
Average Speed (mph)	12	21
Cycle Length (sec)	200	105
Signal Delay/Vehicle (sec)	57	25

Table 1: Network Totals

The simulated plans will reduce the average number of stops per vehicle, increase the average speed by 9 mph, and reduce the cycle length of key intersections to allow for adequate gaps in traffic to accommodate safer left turns along the corridor. Effective green band offset timings have also been developed to produce a smoother traffic flow with reduced travel time.